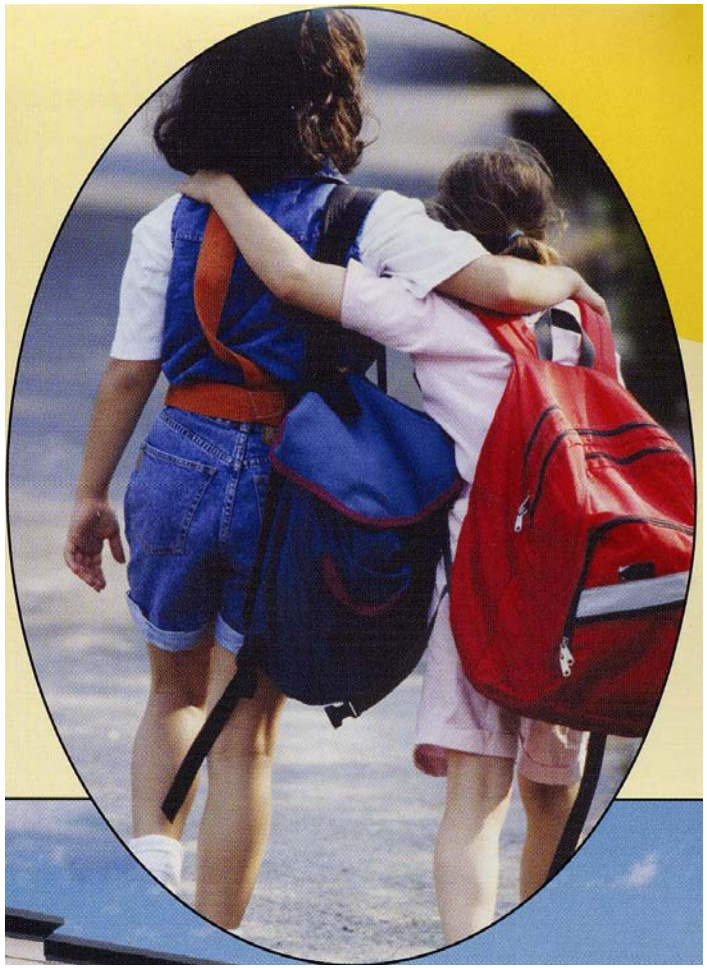
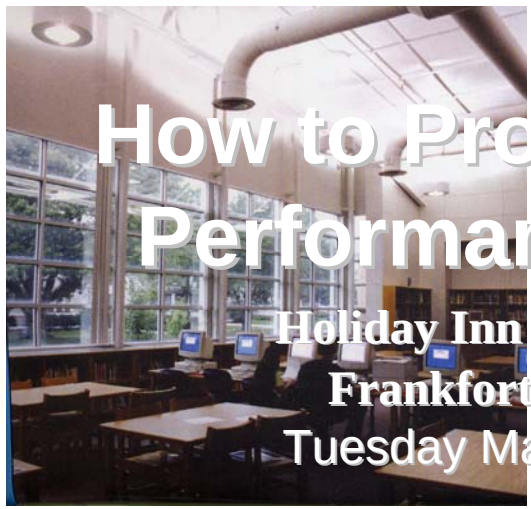
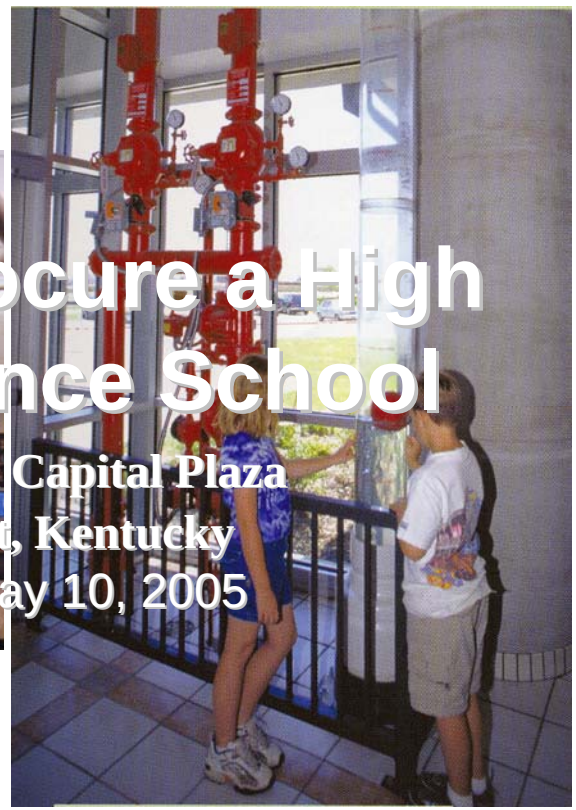
High Performance Sustainable Schools





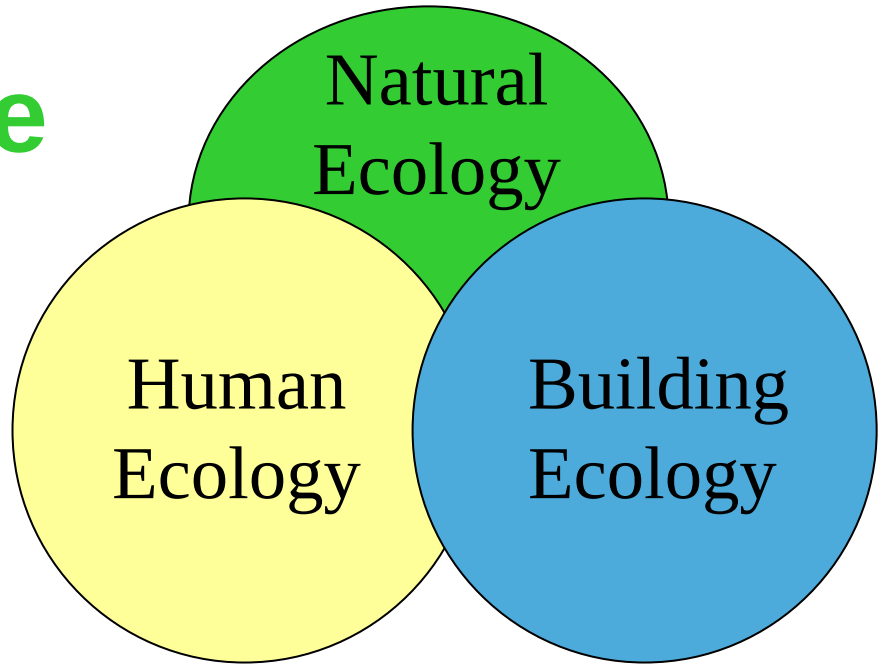


How to Procure a High Performance School

Holiday Inn Capital Plaza
Frankfort, Kentucky
Tuesday May 10, 2005

Robert J. Kobet, AIA
President, Sustainaissance International, Inc.

Collaborative for High Performance Schools (CHPS)

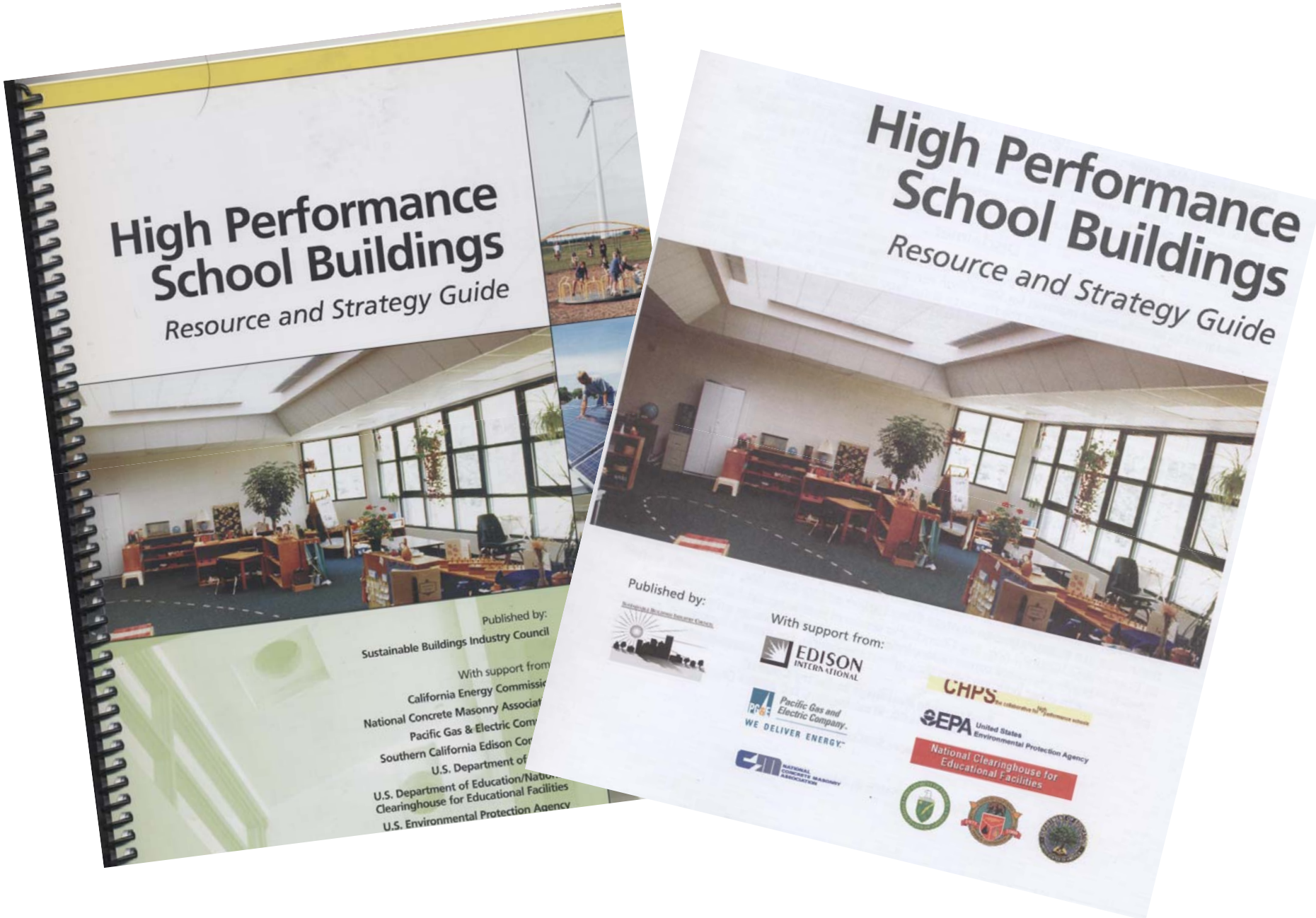


Sustainable Buildings Industry Council (SBIC)

US DOE Rebuild America Program

US Green Building Council

LEED™
LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN


High Performance School Buildings
Resource and Strategy Guide
Published by:
Sustainable Buildings Industry Council
With support from
California Energy Commissi
National Concrete Masonry Associat
Pacific Gas & Electric Com
Southern California Edison Co
U.S. Department of
U.S. Department of Education/Nati
Clearinghouse for Educational Facilities
U.S. Environmental Protection Agency
High Performance School Buildings
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Published by:
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EDISON INTERNATIONAL
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SUSTAINABLE BUILDINGS INDUSTRY COUNCIL

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High-Performance School Buildings Resource and Strategy Guide©

Second Edition

This nationally vetted and easy-to-read guidebook describes the characteristics and benefits of high-performance school buildings and details the process to help school planners ask the right questions of their design professionals to ensure the best school design possible.

New features in the second edition include:

- A new Building Block on Durability
- Updated Building Blocks on Acoustics and Safety/Security
- New Case Studies on Clearview Elementary School (an SBIC "Exemplary Sustainable Building" 2004 Awards Winner) and the North Syracuse Central School District
- New photographs, resources, and Web links

Price:
$50.00; $42.50 (SBIC members)

Volume Pricing: $40.00 (74 or more)

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Why Is a High-Performance School Building Valuable? view this page

Section 2 - Process Guide

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High Performance School Buildings Video/CD-Rom

The 30-minute video showcases 10 successful examples of high-performance schools for communities to consider when they commission a new school or improve an older one. The video is also available on CD-ROM accompanied by a comprehensive PowerPoint presentation.

Read full review

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Site Analysis
Selecting the A/E Team view this page
Programming and Goal Setting
Schematic Design
Design Development
Construction Documents
Bidding and Negotiation
Construction Administration

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6. Energy-Efficient Building Shell
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9. High-Performance HVAC (Heating/Ventilating/Air Conditioning)
10. High-Performance Electric Lighting
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12. Renewable Energy view this page
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15. Thermal Comfort
16. Visual Comfort
17. Water Efficiency

Section 4 - Case Studies
Foreword
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   Boscawen Elementary Q&A
   The Building Blocks of Boscawen Elementary
2. North Syracuse Central School District, North Syracuse, New York
3. Clearview Elementary School, Hanover, Pennsylvania
   The Building Blocks of Clearview Elementary

Section 5: Additional Resources

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What is a High Performance School Building?

Boscawen Elementary School
Boscawen, NH

This 420-student school is day
also utilizes 100% fresh outd
in a system that ensures sup
quality even as it saves ene

"It's light, it's bright, and
space is so efficient for
having come from a m
building. I've already
calmness in the new
wonderful. It's an
going to enhance
efforts. We expec
some remarkab
environment w
working in wi

– Jane Lacas

Characteristics

A high performance school building has three key characteristics:

- It is **healthy and productive** for students and teachers, in that it provides…
  - High levels of acoustic, thermal, and visual comfort;
  - Large amounts of natural daylight;
  - Superior indoor air quality; and
  - A safe and secure environment.
- It is **cost effective** to operate and maintain, because its design employs…
  - Energy analysis tools that optimize energy performance;
  - A life cycle cost approach that reduces the total costs of ownership; and
  - A commissioning process that ensures the facility will operate in a manner consistent with design intent.
- It is **sustainable**, because it integrates…
  - Energy conservation and renewable energy strategies;
  - High performance mechanical and lighting systems;
  - Environmentally responsive site planning;
  - Environmentally preferable materials and products; and
  - Water-efficient design.

Creating a school with these characteristics is not difficult, but it does require an integrated, whole building approach to the design process. Key systems and technologies – the 'building blocks' of a high performance school – must be considered holistically, from the very beginning of the design process, and optimized throughout based on their *combined* impact on the comfort and productivity of students and teachers. At the conclusion of the process, the entire facility will be optimized to achieve long-term value and performance. The result will be a finished school that is an enduring asset to its community; one that enhances teaching and learning, reduces operating costs, and protects the environment.

Building Blocks

The following list summarizes the main Building Blocks of a high performance school – the components which, when integrated as elements of a 'whole building' design, will do the most to create a school that is healthy and productive, cost effective, and sustainable. Each of these topics is covered in detail under the *Building Blocks* section of the *Resource & Strategy Guide*.

- **Acoustic Comfort** – Students and teachers can hear one anoth without shouting. Noise from inside and outside the classroo minimized.
- **Commissioning** – The school operates in accordance with intent and meets the needs of the owner. This is made possibl by implementing a formal commissioning process – a kind of 'systems check' for the facility. The process tests, verifies, and

Introducing the Process Guide

The *Process Guide* presents a step-by-step method for managing the design process in ways that ensure the desired outcome: a high performance school building.

The *Guide* contains a series of questions, organized by design phase, that the 'owners' of a new school (the superintendents, business officials, board members, and others who are guiding the facility development process) can use to ensure that their design team actively considers *all* the key components of a high performance school during each phase of the development process.

Using the *Process Guide*

Over the course of designing and building a new facility, school representatives will meet regularly with their design team to discuss progress. The *Process Guide* should be used to help guide discussion during these meetings.

The *Guide* is divided into eight sections corresponding to key phases in the design/development process:

- Site Analysis
- Selecting the A/E Team
- Programming and Goal Setting
- Schematic Design
- Design Development
- Construction Documents
- Bidding and Negotiation
- Construction Administration

The appropriate section of the *Process Guide* should be consulted at the start of each phase. The list of phase-specific questions should be used to help frame productive discussions with the design team.

The questions in each section of the *Process Guide* are designed to address the key *Building Blocks* of any high performance school:

Acoustic Comfort, Commissioning, Daylighting, Energy Analysis Tools, Environmentally Preferable Materials and Products, Environmentally Responsive Site Planning, High Performance Air Conditioning/Heating/Ventilating Systems, High Performance Electric Lighting, Life Cycle Cost Analysis, Renewable Energy, Safety and Security, Superior Indoor Air Quality, Thermal Comfort, Visual Comfort, and Water Efficiency.

For a quick overview of each of these *Building Blocks* – and a guide to more detailed resources on each topic – consult Section 3 of the *High Performance School Buildings Resource and Strategy Guide*.

"In times of limited resources and faced with an increasing demand for student achievement and accountability, it's critically important for local districts to embrace the strategies and concepts that lead to high performance school buildings."

– Duwayne Brooks
Assistant Superintendent of Public Instruction, California Department of Education

A study by the General Accounting Office shows the types of impacts substandard buildings can have on environmental conditions, and consequently, on teaching and learning. The table below indicates the percentage of schools nationwide reporting unsatisfactory conditions in six key environmental areas (from GAO Report GAO/HEHS –95-61).

Acoustics	28.1%
Ventilation	27.1%
Security	24.2%
Heating	19.2%
Air Quality	19.2%
Lighting	15.6%

Programming and Goal Setting

Questions that will help establish clear, explicit high performance goals as early as possible in the design process – during development of the building's program (the document detailing the basic scope of the project, the types and number of rooms required, etc.).

1. Acoustic Comfort
- ❒ Have good classroom acoustics been established as a design goal for the project?

2. Commissioning
- ❒ Has the team committed to, and budgeted for, commissioning as a basic component of the project?
- ❒ Has a commissioning agent been engaged?

3. Daylighting
- ❒ Has optimized daylighting been specifically established as a design goal for the school and, in particul for the classrooms?

4. Energy Analysis Tools
- ❒ Is the design team required to use an energy analysis tool to help maximize the building's energy performance?
- ❒ What tool has been selected?
- ❒ At what stages in the design process will the tool be used, and what types of analyses will be performed?
- ❒ Has an energy use goal (i.e., a maximum amount of nonrenewable energy the school should con a year) been established? What is it (e.g., __% better than the building code requires)?

5. Energy Efficient Building Shell
- ❒ Has providing an energy efficient building shell been established as a goal for the project?
- ❒ Does the basic programming allow windows on the east and west to be smaller (to reduce un heat gain) and those on the north and south to be larger (to enhance daylighting opportunitie example, does the programming group functions that may need less glazing (auditoriums, ki etc.) on the east and west, and those that will benefit most from daylight (classrooms, corrid the north and south?

6. Environmentally Preferable Materials and Products
- ❒ Has using environmentally preferable materials and products (to the extent feasible) been e a design goal?
- ❒ Has the meaning of 'environmentally preferable' been agreed to by the owner and the de

7. Environmentally Responsive Site Planning
- ❒ Has preserving natural areas on the site been established as a design goal?
- ❒ Is minimizing stormwater runoff a design goal for the site?

8. High Performance HVAC
- ❒ Is using high efficiency heating, ventilating, and air conditioning equipment a design g project?
- ❒ Is 'right sizing' this equipment (by accurately predicting demand and sizing the equip design goal?

9. High Performance Electric Lighting
- ❒ Is a high performance electric lighting system (especially in classrooms) a design goa
- ❒ Is optimizing the interaction between the electric lighting system and any daylightin goal?

10. Life Cycle Cost Analysis
- ❒ Has using some form of life cycle cost analysis methodology been established as design team?
- ❒ What methodology will be used?

Site Analysis

Questions to ask as a potential or actual site is being reviewed.

1. Acoustic Comfort
- ❒ Are there major sources of noise near the site (e.g., highways, shopping areas)?
- ❒ Can the site be used to minimize the impacts of these noise sources (e.g., through planting, earth berms, etc)?

2. Commissioning
- ❒ N/A

3. Daylighting
- ❒ Does the site allow the building to be oriented on an east-west axis, maximizing southern exposure?
- ❒ How will site elements (e.g., existing trees or adjacent buildings) influence the building's access to sunlight?
- ❒ Can the site accommodate one-story construction to allow skylights or roof monitors in the classrooms?

4. Energy Analysis Tools
- ❒ N/A

5. Energy Efficient Building Shell
- ❒ N/A

6. Environmentally Preferable Materials & Products
- ❒ N/A

7. Environmentally Responsive Site Planning
- ❒ Can existing natural areas on the site be preserved?
- ❒ Does the site lend itself to controlling stormwater runoff?
- ❒ What areas of the site could be used as 'outdoor laboratories' for teaching?
- ❒ Is there good pedestrian, mass transit, and/or bicycle access?

8. High Performance HVAC
- ❒ N/A

9. High Performance Electric Lighting
- ❒ N/A

10. Life Cycle Cost Analysis
- ❒ N/A

11. Renewable Energy
- ❒ Does the site have good solar access – for daylighting, active and passive solar heating, solar hot water, and/or photovoltaic systems?
- ❒ Could the site use wind power to generate electricity?

12. Safety and Security
- ❒ Are there clear lines of sight to and from the school building throughout the site?
- ❒ Are there areas (depressions in the ground, stands of trees, thick shrubs) where people can be hidden from view?

13. Superior Indoor Air Quality
- ❒ Is the site near any sources of outdoor pollution?

14. Thermal Comfort
- ❒ Are there prevailing breezes that could be used to help naturally ventilate the building?

15. Visual Comfort
- ❒ Does the site provide special views that should be preserved?

Selecting the A/E Team

Questions to ask prospective Architecture/Engineering teams to ensure that they have the necessary experience and qualifications to deliver a high performance school.

1. Acoustic Comfort
   - ❒ How has the team addressed acoustic performance in previous projects?
   - ❒ What specific strategies has the team used to ensure acoustic quality?
   - ❒ How has the team applied these strategies in classrooms?
2. Commissioning
   - ❒ Have any of the team's previous buildings (especially schools) gone through a commissioning process?
   - ❒ How detailed was the commissioning? Who acted as commissioning agent?
   - ❒ What were the results?
3. Daylighting
   - ❒ What examples can the team provide of previous projects that incorporate daylighting?
   - ❒ Are any of these examples schools, especially classrooms?
   - ❒ What daylighting strategies did the team use?
   - ❒ Are the occupants satisfied with the results?
   - ❒ Are the strategies saving energy? How much?
   - ❒ What analysis tool does the team use to optimize performance of the daylighting systems it design
4. Energy Analysis Tools
   - ❒ What energy analysis tool(s) does the team use on its projects?
   - ❒ How does it use the tool(s) to reduce energy consumption in its designs?
   - ❒ Has it applied the tools to school design? What were the results?
   - ❒ What tool(s) does the team propose for the project under discussion?
5. Energy Efficient Building Shell
   - ❒ How has the team achieved energy efficient walls, floors, and roofs on previous projects?
   - ❒ What key techniques, materials, and products were used and what was the resulting im
     performance?
   - ❒ Are the systems still performing as designed?
6. Environmentally Preferable Materials and Products
   - ❒ What experience does the team have in specifying environmentally responsible ma
     in its projects?
   - ❒ Does the team have knowledge of how these materials and products can be pro
     are installed?
   - ❒ Does the team have knowledge of how these materials and products perform
   - ❒ Has the team ever specified environmentally responsible materials and produc
7. Environmentally Responsive Site Planning
   - ❒ Has the team created environmentally responsive/responsible site plans bef
   - ❒ What were the key features and how are they performing?
8. High Performance HVAC (heating/ventilating/air conditioning)
   - ❒ Does the team specify high performance HVAC systems as standard pr
   - ❒ What tools does the team use to analyze and optimize the performan
   - ❒ What high performance HVAC systems has the team put in place in
     schools)?
   - ❒ How much energy was saved as a direct result of specifying these
   - ❒ How have these systems performed over time?
9. High Performance Electric Lighting
   - ❒ Does the team have experience designing high performance el
     schools)?
   - ❒ Are these systems providing a high quality visual environme

Resources

Acoustical Society of America
2 Huntington Quadrangle, Suite 1NO1
Melville, NY 11747-4502
t: 516-576-2360
f: 516-576-2377
e: asa@aip.org
http://asa.aip.org

American Institute of Architects
Committee on the Environment (COTE)
1735 New York Ave., NW
Washington, DC 20006
t: 202-626-7300
www.e-architect.com

American Solar Energy Society
2400 Central Avenue, Suite G-1
Boulder, CO 80301
t: 303-443-3130
f: 303-443-3212
e: ases@ases.org
www.ases.org/solarguide

Collaborative for High Performance Schools (CHPS)
c/o Eley Associates
142 Minna Street
San Francisco, California 94105
t: 415-957-1977
www.chps.net

Database of State Incentives for Renewable Energy (DSIRE)
North Carolina Solar Center
Box 7401, N.C. State University
Raleigh, North Carolina 27695-7401
t: 919-515-3480 or 800-33-NC SUN (toll-free in N.C.)
http://www-solar.mck.ncsu.edu/dsire.htm

Energy Smart Schools Program
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0121
t: 800-DOE-3732
www.eren.doe.gov/buildings/rebuild

U.S. Green Building Council

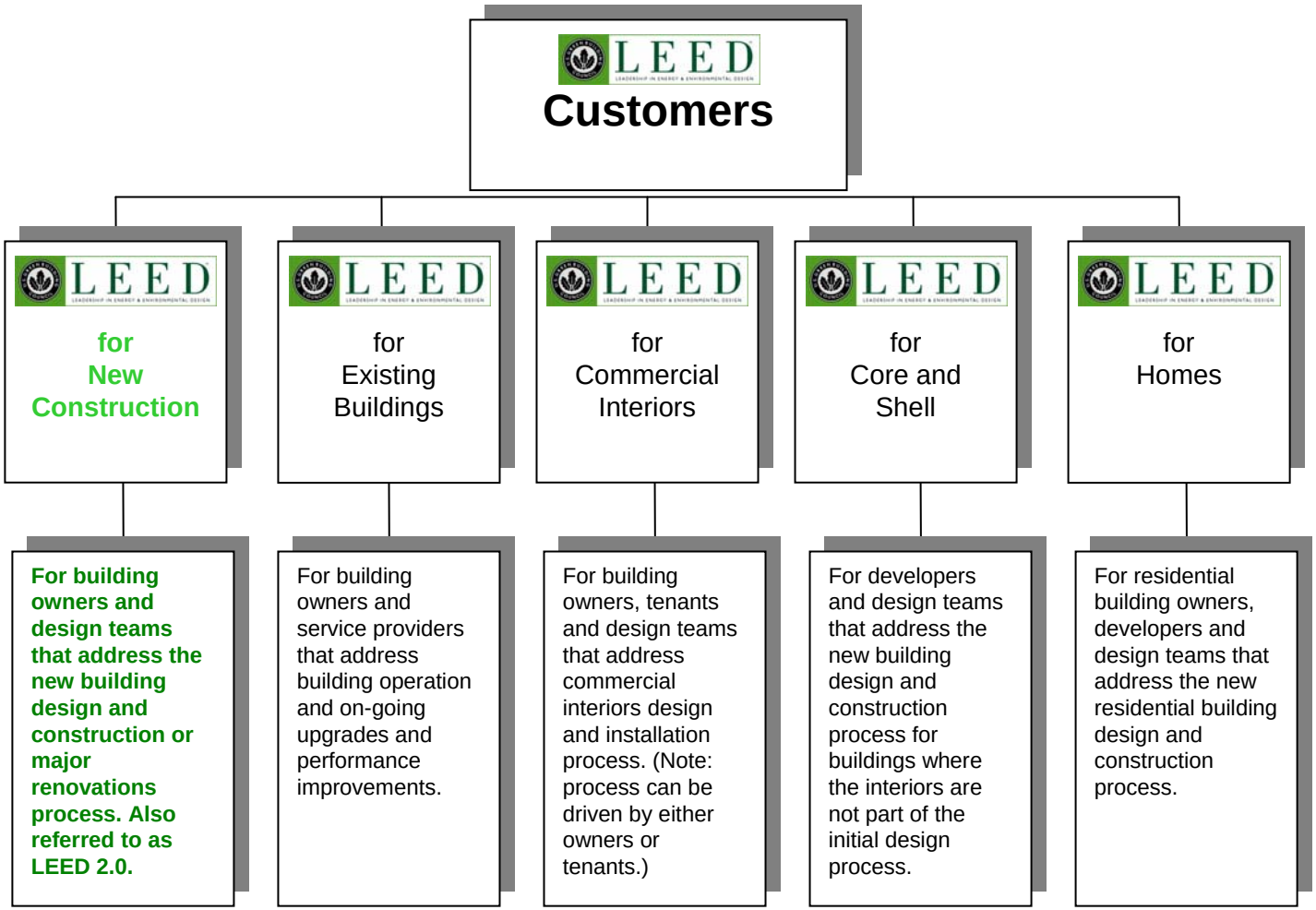
- National, non-profit organization
- Voluntary, diverse membership that operates on consensus principles
- Developer and administrative authority of the LEED Green Building Rating System
- **Purpose is to:**
  - **Integrate**
  - **Lead**
  - **Educate**

What is Green Design?

(According to the USGBC)

- Design and construction practices that significantly reduce or eliminate the negative impact of buildings on the environment and occupants that address:
  - **Sustainable site planning**
  - **Safeguarding water and water efficiency**
  - **Energy efficiency**
  - **Conservation of materials and resources**
  - **Indoor environmental quality**

Leadership in Energy and Environmental Design



LEED Application Guides

Application Guide	Status
Lodging	Available
Campus	Pending Approval
Retail	Development
Healthcare	Development
Laboratories	Development
Schools	**Development**

LEED Development Schedule

2000 → Released LEED 2.0

2001 → Solidified foundation of LEED 2.0

- Building Tools – Reference Package

2004 → Launched LEED-NC 2.1

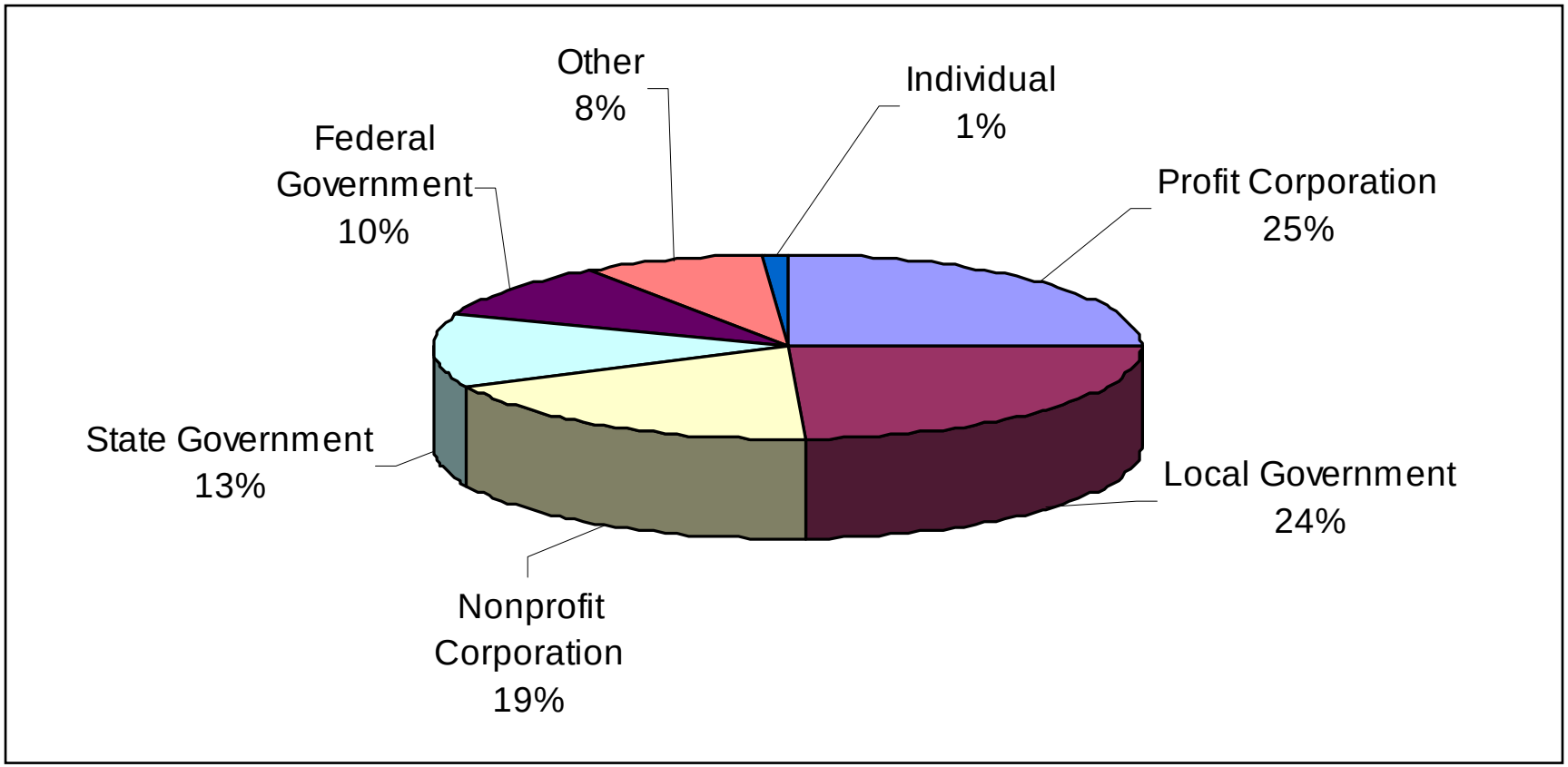
2004-5 → Introduce LEED to new markets

- Existing Buildings (LEED-EB)
- Commercial Interiors (LEED-CI)
- Core & Shell (LEED-CS)

2005 → Develop LEED-NC 2.2

- Test new criteria & build support
- Launch LEED-NC 2.2

Who's doing it?

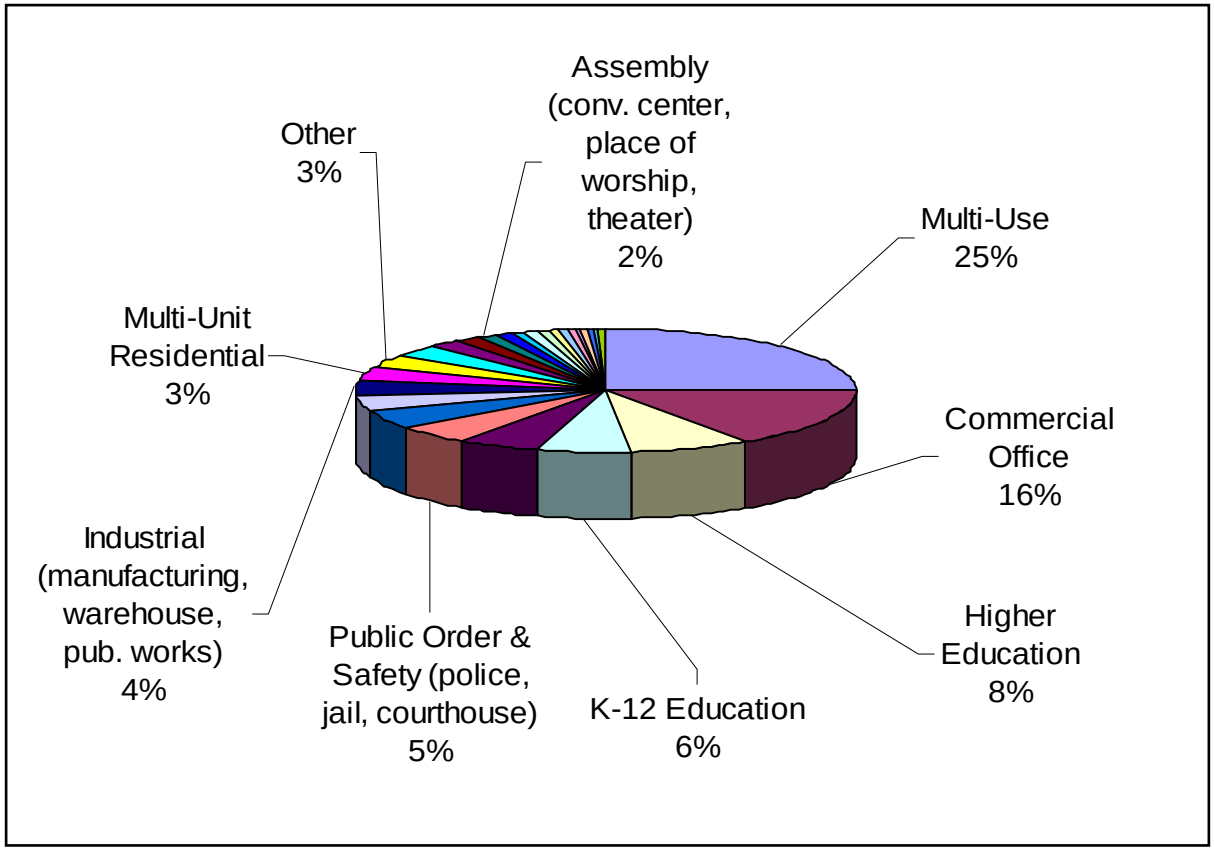


USGBC Registered Projects by Owner Type

USGBC LEED Projects As of 09.20.04

All statistics exclude pilot projects

What about schools?



There are 130 projects registered in whole or in part listing K – 12 as the primary function

As of 01.31.05

All statistics exclude pilot projects

K-12 School Buildings Application Guide based on the Green Building Rating System

For New Construction & Major Renovations (LEED®-NC) Version 2.2

LEED Application Guide for Schools Committee

Member	Title	Company/Affiliation	Attendance
Ms. Anja Caldwell	Voting Member	Montgomery County Public Schools	x
Mr. Gregory Churchill	Voting Member	Oregon Department of Energy	x
Mr. Charles Eley	Voting Member	Architectural Energy Corporation	x
Mr. Deane Evans	Voting Member	NJ Institute of Technology	x
Mr. Bob Kobet	Chair	Sustainaissance International	x
Mr. William Orr	Voting Member	CA Integrated Waste Manage. Board	x
Dr. Stan Pritchett	Voting member	Dekalb County School System	
Brenda Stokes	For Dr. Pritchett	Dekalb (LEED Professional)	
Mr. Larry Schoff	Voting Member	US DOE Rebuild America	x
Ms. Jyoti Sharma	Vice Chair	Wake County Public School System	x
Ms. Katrina Shum-Miller	Voting Member	Green Building Services	
Mr. Tim Sisson	Voting Member	Guttmann & Blaevoet Consulting Eng.	x
Peter Templeton	LEED Deputy Director	USGBC	
Emily Turk	USGBC staff liaison	USGBC	x
Lindsay Baker	USGBC staff support	USGBC	x
Max Zahniser	LEED Certif. Assistant	USGBC	x
John Amatruda	Contractor (LEED AP)	Steven Winter Associates, Inc. (SWA)	
Bambi Tran	Contractor (LEED AP)	SWA	x
Ellen Larson Vaughan	Contractor	SWA	x

Total Project Score — Possible Points 69

Certified 26 to 32 points **Silver** 33 to 38 points **Gold** 39 to 51 points **Platinum** 52 or more points

Sustainable Sites — Possible Points 14

Y	?	N			
Y			Prereq 1	**Erosion & Sedimentation Control**	
			Credit 1	**Site Selection**	1
			Credit 2	**Urban Redevelopment**	1
			Credit 3	**Brownfield Redevelopment**	1
			Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
			Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
			Credit 4.3	**Alternative Transportation**, Alternative Fuel Refueling Stations	1
			Credit 4.4	**Alternative Transportation**, Parking Capacity	1
			Credit 5.1	**Reduced Site Disturbance**, Protect or Restore Open Space	1
			Credit 5.2	**Reduced Site Disturbance**, Development Footprint	1
			Credit 6.1	**Stormwater Management**, Rate and Quantity	1
			Credit 6.2	**Stormwater Management**, Treatment	1
			Credit 7.1	**Landscape & Exterior Design to Reduce Heat Islands**, Non-Roof	1
			Credit 7.2	**Landscape & Exterior Design to Reduce Heat Islands**, Roof	1
			Credit 8	**Light Pollution Reduction**	1

Water Efficiency — Possible Points 5

Y	?	N			
			Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
			Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
			Credit 2	**Innovative Wastewater Technologies**	1
			Credit 3.1	**Water Use Reduction**, 20% Reduction	1
			Credit 3.2	**Water Use Reduction**, 30% Reduction	1

Energy & Atmosphere — Possible Points 17

Y	?	N			
Y			Prereq 1	**Fundamental Building Systems Commissioning**	
Y			Prereq 2	**Minimum Energy Performance**	
Y			Prereq 3	**CFC Reduction in HVAC&R Equipment**	
			Credit 1.1	**Optimize Energy Performance**, 20% New / 10% Existing	2
			Credit 1.2	**Optimize Energy Performance**, 30% New / 20% Existing	2
			Credit 1.3	**Optimize Energy Performance**, 40% New / 30% Existing	2
			Credit 1.4	**Optimize Energy Performance**, 50% New / 40% Existing	2
			Credit 1.5	**Optimize Energy Performance**, 60% New / 50% Existing	2
			Credit 2.1	**Renewable Energy**, 5%	1
			Credit 2.2	**Renewable Energy**, 10%	1
			Credit 2.3	**Renewable Energy**, 20%	1
			Credit 3	**Additional Commissioning**	1
			Credit 4	**Ozone Depletion**	1
			Credit 5	**Measurement & Verification**	1
			Credit 6	**Green Power**	1

Materials & Resources — Possible Points 13

Y	?	N			
Y			Prereq 1	**Storage & Collection of Recyclables**	
			Credit 1.1	**Building Reuse**, Maintain 75% of Existing Shell	1
			Credit 1.2	**Building Reuse**, Maintain 100% of Existing Shell	1
			Credit 1.3	**Building Reuse**, Maintain 100% Shell & 50% Non-Shell	1
			Credit 2.1	**Construction Waste Management**, Divert 50%	1
			Credit 2.2	**Construction Waste Management**, Divert 75%	1
			Credit 3.1	**Resource Reuse**, Specify 5%	1
			Credit 3.2	**Resource Reuse**, Specify 10%	1
			Credit 4.1	**Recycled Content**, Specify 25%	1
			Credit 4.2	**Recycled Content**, Specify 50%	1
			Credit 5.1	**Local/Regional Materials**, 20% Manufactured Locally	1
			Credit 5.2	**Local/Regional Materials**, of 20% Above, 50% Harvested Locally	1
			Credit 6	**Rapidly Renewable Materials**	1
			Credit 7	**Certified Wood**	1

Indoor Environmental Quality — Possible Points 15

Y	?	N			
Y			Prereq 1	**Minimum IAQ Performance**	
Y			Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	
			Credit 1	**Carbon Dioxide** (CO_2) **Monitoring**	1
			Credit 2	**Increase Ventilation Effectiveness**	1
			Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
			Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
			Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
			Credit 4.2	**Low-Emitting Materials**, Paints	1
			Credit 4.3	**Low-Emitting Materials**, Carpet	1
			Credit 4.4	**Low-Emitting Materials**, Composite Wood	1
			Credit 5	**Indoor Chemical & Pollutant Source Control**	1
			Credit 6.1	**Controllability of Systems**, Perimeter	1
			Credit 6.2	**Controllability of Systems**, Non-Perimeter	1
			Credit 7.1	**Thermal Comfort**, Comply with ASHRAE 55-1992	1
			Credit 7.2	**Thermal Comfort**, Permanent Monitoring System	1
			Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
			Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1

Innovation & Design Process — Possible Points 5

Y	?	N			
			Credit 1.1	**Innovation in Design**: Specific Title	1
			Credit 1.2	**Innovation in Design**: Specific Title	1
			Credit 1.3	**Innovation in Design**: Specific Title	1
			Credit 1.4	**Innovation in Design**: Specific Title	1
			Credit 2	**LEED™ Accredited Professional**	1

Key for AG Committee:

Black = Don't Change
Blue = Modify
Yellow = Clarify
Red = Defer
Purple = Delete]
Green = New Credits
Pink = Change to Prerequisite

Sustainable Sites **14 Possible Points**

Prereq 1	**Erosion & Sedimentation Control**	Required
Credit 1	**Site Selection**	1
Credit 2	**Development Density & Community Connectivity**	1
Credit 3	**Brownfield Redevelopment**	1
Credit 4.1	**Alternative Transportation, Public Transportation Access**	**1**
Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
Credit 4.3	**Alternative Transportation**, Low Emitting & Fuel Efficient Vehicles	1
Credit 4.4	**Alternative Transportation**, Parking Capacity and Car sharing	1
Credit 5.1	**Site Development**, Protect or Restore Habitat	1
Credit 5.2	**Site Development**, Maximize Open Space	1
Credit 6.1	**Storm water Design**, Volume/Treatment	1
Credit 6.2	**Storm water Design**, Channel Protection/Flood Control	1
Credit 7.1	**Heat Island Effect**, Non-Roof	1
Credit 7.2	**Heat Island Effect**, Roof	1
Credit 8	**Light Pollution Reduction**	1

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Water Efficiency **5 Possible Points**

Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
Credit 2	**Innovative Wastewater Technologies**	1
Credit 3.1	**Water Use Reduction**, 20% Reduction	1
Credit 3.2	**Water Use Reduction**, 30% Reduction	1

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Energy & Atmosphere **17 Possible Points**

Prereq 1	**Fundamental Commissioning of the Building Energy Systems**	Required
Prereq 2	**Minimum Energy Performance**	Required
Prereq 3	**CFC Reduction in HVAC&R Equipment**	Required
Credit 1	**Optimize Energy Performance**	1 – 10
Credit 2.1	**Renewable Energy**, 5%	1
Credit 2.2	**Renewable Energy**, 10%	1
Credit 2.3	**Renewable Energy**, 20%	1
Credit 3	**Enhanced Commissioning**	1
Credit 4	**Refrigerant Selection**	1
Credit 5	**Measurement & Verification**	1
Credit 6	**Green Power**	1

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Materials & Resource 13 Possible Points

Prereq 1	**Storage & Collection of Recyclables**	Required
Credit 1.1	**Building Reuse**, Maintain 75% of Existing Walls, Floors & Roof	1
Credit 1.2	**Building Reuse**, Maintain 95% of Existing Walls, Floors & Roof	1
Credit 1.3	**Building Reuse**, Maintain 50% of Interior Non-Structural Elements	1
Credit 2.1	**Construction Waste Management**, Divert 50% from Disposal	1
Credit 2.2	**Construction Waste Management**, Divert 75% from Disposal	1
Credit 3.1	**Resource Reuse**, Specify 5%	1
Credit 3.2	**Resource Reuse**, Specify 10%	1
Credit 4.1	**Recycled Content**, Specify 10% (post-consumer + ½ pre-consumer)	1
Credit 4.2	**Recycled Content**, Specify 20% (post-consumer + ½ pre-consumer)	1

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Materials & Resources (continued)

Credit 5.1	**Regional Materials**	
	10% Extracted, Processed & Manufactured Regionally	1
Credit 5.2	**Regional Materials**	
	20% Extracted, Processed & Manufactured Regionally	1
Credit 6	**Renewable Materials**	1
Credit 7	**Certified Wood**	1

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Indoor Environmental Quality **15 Possible Points**

Prereq 1	**Minimum IAQ Performance**	Required
Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	Required
Credit 1	**Outdoor Air Delivery Monitoring**	1
Credit 2	**Increased Ventilation**	1
Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
Credit 4.2	**Low-Emitting Materials**, Paints & Coatings	1
Credit 4.3	**Low-Emitting Materials**, Carpet Systems	1
Credit 4.4	**Low-Emitting Materials**, Composite Wood & Laminate Adhesives	1

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Indoor Environmental Quality (continued)

Credit 5	**Indoor Chemical & Pollutant Source Control**	1
Credit 6.1	**Controllability of Systems**, Lighting	1
Credit 6.2	**Controllability of Systems**, Temperature & Ventilation	1
Credit 7.1	**Thermal Comfort**, Compliance	1
Credit 7.2	**Thermal Comfort**, Monitoring	1
Credit 8.1	**Daylight & Views, Daylight 75% of Spaces**	1
Credit 8.2	**Daylight & Views, Views from 90% of Spaces**	1

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Innovation & Design / New Credits **5 Possible Points**

Credit 1.1	**Classroom Acoustics**	1
Credit 1.2	**Educational Outreach/Curriculum**	1
Credit 1.3	**Innovation in Design: Green Housekeeping or IPM/Org Landscape**	1
Credit 1.4	**Innovation in Design: Design for Durability or Future Expansion**	1

Credit 2 **LEED Accredited Professional** 1

Project Totals 69 Possible Points

Certified 26-32 points **Silver** 33-38 points **Gold** 39-51 points **Platinum** 52-69 points

SS Credit 4.2: Alternative Transportation – Bicycle Storage & Changing Rooms

1 Point

(Note: This is a "Modified" Credit)

Intent

Reduce pollution and land development impacts from automobile use.

Requirements

For commercial or institutional buildings, provide secure bicycle storage with convenient changing/shower facilities (within 200 yards of the building) for 5% or more of regular building occupants. For residential buildings, provide covered storage facilities for securing bicycles for 15% or more of building occupants in lieu of changing/shower facilities.

Requirements for Schools

For elementary schools and middle schools, provide secure bicycle storage for 5% or more of the regular student population at Grades 5 and higher, **AND** provide separate secure bicycle storage with convenient changing/shower facilities (within 200 yards of the building) for 5% or more of the regular adult building occupants (e.g., teachers, administrators, operations and maintenance staff), **AND** provide bike lanes and sidewalks that extend at least to the end of the school zone.

For high schools, provide secure bicycle storage with convenient changing/shower facilities (within 200 yards of the building) for 5[JA1] % or more of the regular student population, **AND** provide separate secure bicycle storage with convenient changing/shower facilities (within 200 yards of the building) for 5% or more of the regular adult building occupants (e.g., teachers, administration staff, operations and maintenance staff), **AND** provide bike lanes and sidewalks that extend at least to the end of the school zone.

Submittals

❑For commercial projects: provide the LEED-NC Letter Template, signed by the Architect or responsible party, declaring the distance to bicycle storage and showers from the building entrance and demonstrating that these facilities can accommodate at least 5% of building occupants.

OR

❑For residential projects: provide the LEED-NC Letter Template, signed by the architect or responsible party, declaring the design occupancy for the buildings, number of covered bicycle storage facilities for securing bicycles, and demonstrating that these facilities can accommodate at least 15% of building occupants.

OR

For Schools: provide the LEED-NC Letter Template, signed by the Architect or responsible party, declaring the distance to bicycle storage and showers from the building entrance and demonstrating that these facilities can accommodate at least 5% of the targeted building occupancy.

Potential Technologies & Strategies

Design the building with transportation amenities such as bicycle racks and showering/changing facilities.

Supplementary Guidance for Schools

Most schools are situated within close proximity to residential districts; as such the opportunities for bicycle commuting can be significant in many communities. In the schools context, safety considerations are paramount. Design considerations include:

clear separation between vehicular and bicycle traffic (including clearly marked bicycle lanes and sidewalks that extend throughout the entire school zone);

secure bicycle storage (e.g., exterior bicycle racks located near entryways and administrative offices, interior bicycle storage rooms with controlled access); and

well-designed exterior lighting that provides clear visibility and appropriate security.

In addition to the physical facilities, schools should have clear policies related to appropriate bicycle uses on school grounds.

In calculating the appropriate number of building occupants to meet LEED criteria, students are considered Full-Time-Equivalent (FTE) occupants, even if their school day is less than eight hours. The number of bicycle slots for students is based on the maximum enrollment capacity of the school, even if this is greater than the current student enrollment.

A minimum of one shower is required for every eight bicycling occupants. Shower and locker rooms associated with gymnasiums or natatoriums can be designated as the showering/changing facilities for students, provided they are within 200 yards of the main facility[JA1] . These rooms cannot be claimed as the changing/showering facilities for the adult building occupants, however, unless clear separation between the student and adult facilities is demonstrated.

References

(Note: the following references are from CHPS. There are no bicycle-related references in the LEED 2.1 Reference Guide. Any Committee suggestions, such as references on school bicycle safety?)

Bicycle Federation of America. Comprehensive coverage of a host of policy, planning and design guidelines supporting bicycle use. Internet Resource Center. http://www.bikefed.org/. April 1999.

Cox, E. (April 1999). Long Term Bike Parking. Useful overview of design considerations for long-term bicycle storage offering essential and optional features for caged facilities, bike rooms, bike lockers and shower and clothes locker rooms. http://www.jps.net/cbc/longbikepark.html.

IESNA. 1980. RP-8 Roadway Lighting, Chapter 4, Pedestrian Walkway and Bikeway Lighting Design, Illuminating Engineering Society of North America (IESNA), New York. This document contains guidelines for the design of fixed lighting

WE Credit 3.1 Water Use Reduction- 20% Reduction

1 Point

(Note: This is a "Clarified" Credit)

Intent

Maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

Requirements

Employ strategies that in aggregate use 20% less water than the water use baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992 fixture performance requirements.

Submittals

❑Provide the LEED-NC Letter Template, signed by the MEP engineer or responsible party, declaring that the project uses 20% less water than the baseline fixture performance requirements of the Energy Policy Act of 1992.

❑Provide the spreadsheet calculation demonstrating that water-consuming fixtures specified for the stated occupancy and use of the building reduce occupancy-based potable water consumption by 20% compared to baseline conditions

Potential Technologies & Strategies

Estimate the potable and non-potable water needs for the building. Use high-efficiency fixtures, dry fixtures such as composting toilets and waterless urinals, and occupant sensors to reduce the potable water demand. Consider reuse of stormwater and greywater for non-potable applications such as toilet and urinal flushing, mechanical systems and custodial uses.

Supplementary Guidance for Schools

This scope of this credit is limited to internal plumbing fixtures: faucets, showers, toilets, and urinals. Because of this defined scope, the strategies that schools would likely employ to meet the credit criteria include the following:

Low-flow lavatory faucets/aerators (rated at 2.0 gpm or less)
Ultra-low flow lavatory faucets (rated at 0.5 gpm)
Electronic (infrared) sensors or spring-activated controls to automatically turn faucets on and off
Low-flow showerheads (rated at 2.0 gpm or less)
Low-flow faucets at pantry sinks (rated at 2.0 gpm or less)

Additional strategies that might be considered include:

Dual flush toilets (1.6/0.8 gpf[JA1])
Ultra low flush toilets (1.1 – 1.4/gpf[JA2])
Foot pedal controls for lavatories
Low flow urinals (rated at 0.5 gal/flush)
Waterless urinals

As demonstrated in Tables XX and YY in the “Sample Calculations” section below, water savings between 20-30% can often be achieved through no or low cost measures - primarily faucet and shower aerators. Savings of 30% or more, however, may involve emerging technologies such as low-flow urinals, dual-flush toilets, or waterless urinals (See Table ZZ, under WE Credit 3.2). Schools with stormwater, greywater, and/or blackwater recycling systems can also apply the recycled water use toward this credit calculation, if the water is used for toilet or urinal flushing.
While the water demands of cooling towers, swimming pools, labs and commercial kitchens are currently considered “process loads” in the LEED system (and are therefore not included in this credit), these items can sometimes be the most significant water consumers in a school facility. Design teams are encouraged to implement water efficiency strategies in these specialized applications (see options under WE Credit 3.2), [JA1] which can provide significant water and sewer cost savings. These measures can also potentially earn a LEED Innovation credit under WE Credit 3.2 for exemplary performance.

Sample Calculations

The following sample calculations illustrate how faucet and shower aerators can be used to achieve WE Credit 3.1.

Table XX: Design Case (Water-efficiency measures highlighted in green)

Flush Fixture	Daily Uses	Flowrate [GPF]	Duration [flush]	Auto Controls N/A	Occupants	Water Use [gal]
Conventional Water Closet (Male)	1	1.6	1	--	550	880
Conventional Water Closet (Female)	3	1.6	1	--	550	2,640
Conventional Urinal (Male)	2	1.0	1	--	550	1,100
Conventional Urinal (Female)	0	1.0	1	--	550	0
Flow Fixture	Daily Uses	Flowrate [GPM]	Duration [sec]	Auto Controls [% savings]	Occupants	Water Use [gal]
Low Flow Lavatory	3	0.5	15	--	1,100	413
Low Flow Shower	1	2.0	300	--	100	1,000
Low Flow Pantry Sink	1	2.0	30	--	50	50
					Total Daily Volume [gal]	6,083
					Annual School Days	180
					Annual Volume [gal]	1,094,850
					Annual Graywater or Stormwater Reuse [gal]	0
					TOTAL ANNUAL VOLUME [gal]	**1,094,850**
Water Use Reduction (compared to Baseline)						**24%**

Flush Fixture	Daily Uses	Flowrate [GPF]	Duration [flush]	Auto Controls N/A	Occupants	Water Use [gal]
Conventional Water Closet (Male)	1	1.6	1	--	550	880
Conventional Water Closet (Female)	3	1.6	1	--	550	2,640
Conventional Urinal (Male)	2	1.0	1	--	550	1,100
Conventional Urinal (Female)	0	1.0	1	--	550	0

Flow Fixture	Daily Uses	Flowrate [GPM]	Duration [sec]	Auto Controls [% savings]	Occupants	Water Use [gal]
Lavatory	3	2.5	15	--	1,100	2,063
Shower	1	2.5	300	--	100	1,250
Pantry Sink	1	2.5	30	--	50	63

Table YY: Baseline Case

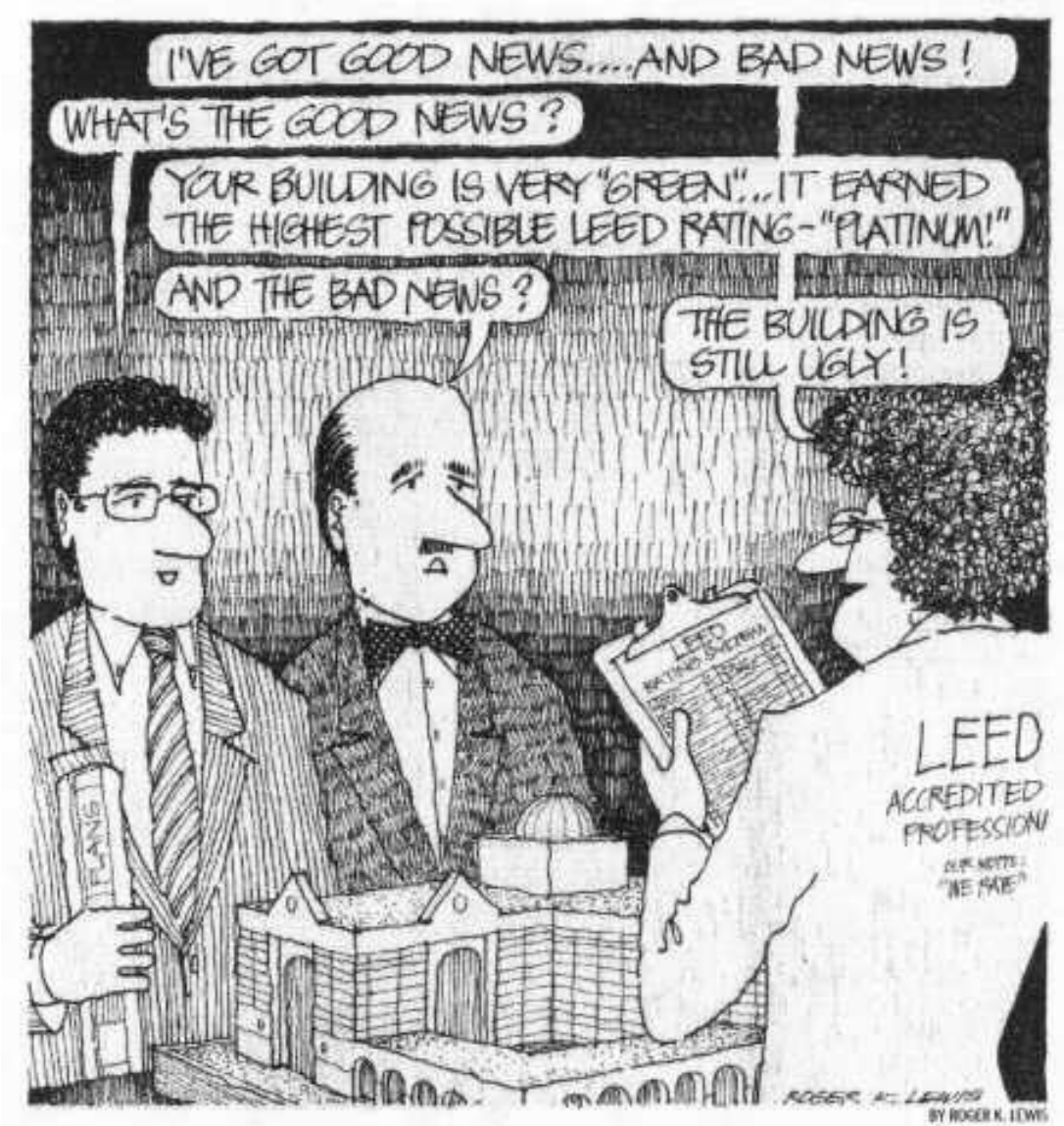
Total Daily Volume [gal]	7,995
Annual School Days	180
Annual Volume [gal]	1,439,100
Annual Graywater or Stormwater Reuse [gal]	0
TOTAL ANNUAL VOLUME [gal]	**1,439,100**

References

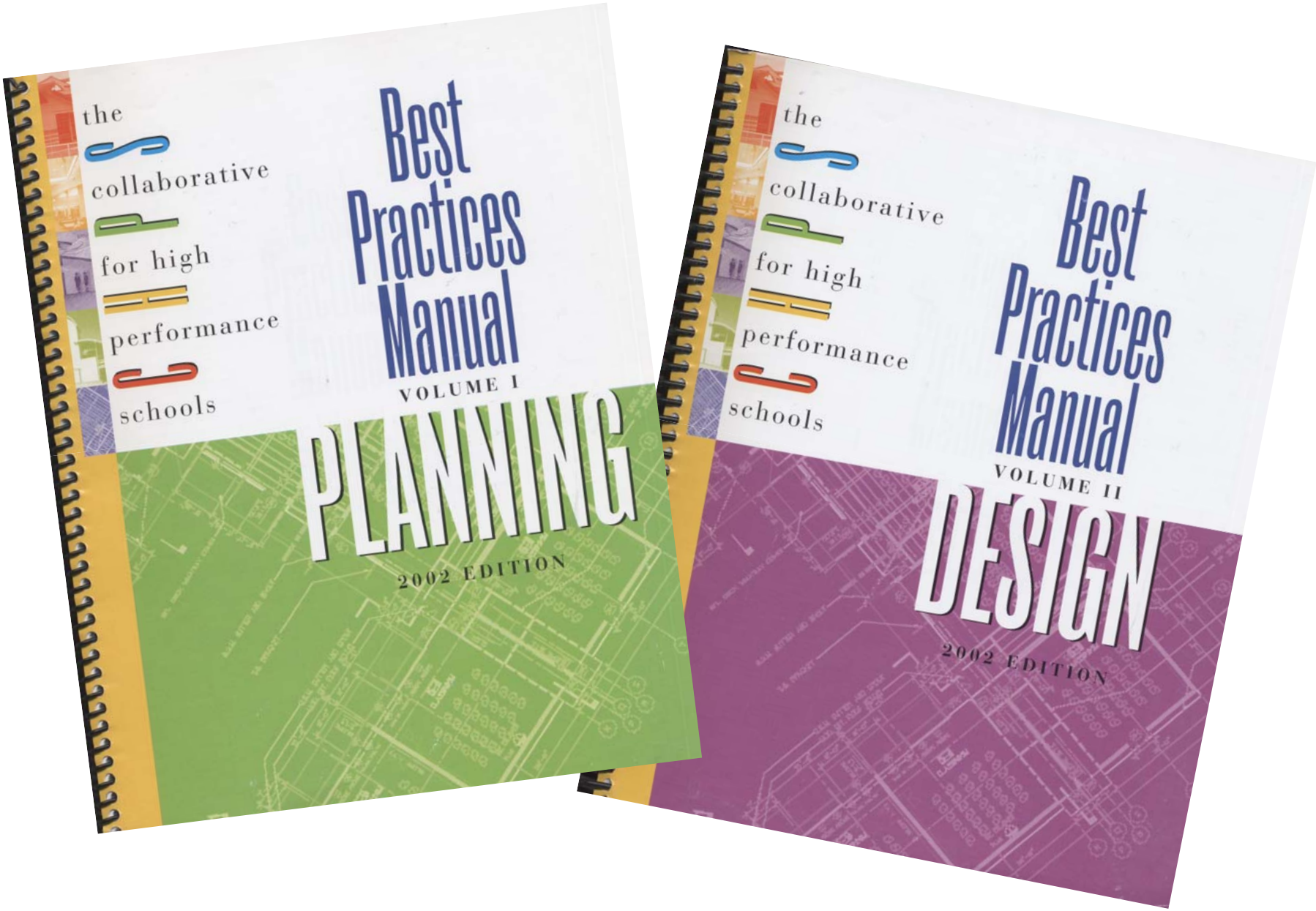
(Note:The LEED 2.1 Reference Guide includes some general water-efficiency references. CHPS does not include specific water efficiency references, other than manufacturer information for waterless urinals. Any Committee suggestions specific to schools?)

Examples

Committee suggestions?



Yes, but is it a good learning environment?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collaborative
for high
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Best Practices Manual
VOLUME I
PLANNING
2002 EDITION
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for high
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schools
Best Practices Manual
VOLUME II
DESIGN
2002 EDITION

UNDERSTANDING HIGH PERFORMANCE SCHOOLS

High performance schools are facilities that improve the learning environment while saving energy, resources, and money. So what's the catch? Aren't these designs prohibitively expensive and time consuming? The short answer is no; the key lies in understanding the lifetime value of high performance schools, hiring skilled designers, and effectively managing priorities during the design and construction process. The detailed answer is woven throughout this manual and addresses these important issues facing schools today:

- How will high performance schools help educate students? High performance design can have a positive effect on health and comfort, and design strategies such as daylighting have been shown to enhance student learning. Good indoor air quality is essential for teacher and student health. Good design also produces more comfortable environments with proper lighting, air temperature, humidity, and noise levels. These factors reduce distractions and create environments where students and teachers can see clearly, hear accurately, and not feel too warm or too cold.
- Is high performance design cost effective? Yes. High performance design creates environments that are energy and resource efficient. These increased efficiencies save money on utility bills and are so valuable that some organizations will provide building owners with funds to have them included in the design. Furthermore, healthier environments can bring money into the school by lowering absenteeism and increasing funding based on average daily attendance. These financial, health, and productivity benefits are the result of integrated design: understanding how building elements affect one another to optimize the performance of the entire school.
- Do I have to choose between housing more students and high performance? No. Because a school facility must be able to house as many students as possible, building high performance schools at the expense of fewer classrooms is not an option. The key is to identify goals and budgets in advance and to verify that the designers and contractors explicitly understand your needs and their responsibilities, and have the skills to deliver what you want. School construction budgets are tight, but cost-effective solutions can be found for nearly any budget.
- Will I have the time to do this? Yes. School design and construction timelines are short, but better design does not have to be a roadblock. As a district, you must identify your educational and high performance goals early and communicate them clearly with the design team. Integrate your goals into the design from an early stage and implement commissioning to reduce time- and money-intensive changes later in the process. The CHPS Criteria (Volume III) is a convenient and flexible system for identifying your high performance goals. A pre-design goal setting meeting (sometimes referred to as a "charrette") with all of the stakeholders, using the CHPS Criteria as a guide, can aid this effort.
- Do I need to be an expert in high performance building design? No. It's the architect's and engineer's role to make sure the design is as effective as possible. You must, however, identify and prioritize your goals, and hire designers with the appropriate skill sets. Without the luxury of expansive timelines and budgets, every school design becomes a balanced

FINANCING HIGH PERFORMANCE SCHOOLS

High performance schools are cost effective for a number of reasons. For example, they can:

- Bring more money to the school by increasing average daily attendance.
- Keep more money in the school by significantly reducing utility bills.
- Take advantage of currently available incentive programs.

When the avoided costs of workers' compensation claims and litigation are also considered, high performance schools become an even wiser business choice for school districts. Discussed below are issues related to financing high performance schools, including life-cycle costing, reduced operating expenses, increased funds, financial incentive and technical assistance programs, avoided costs, and reduced litigation risks.

Life-Cycle Costing

School facilities are investments. State government and local communities spend billions of dollars per year on new facilities for current and future generations of students. Unfortunately, the institutional separation of operational and construction budgets can create schools that are economically, environmentally, and educationally poor investments.

Many high performance measures can be incorporated into a school design without increasing first costs, but additional investments can increase the health and efficiency of the school even further. However, if a conventional financing methodology is used, design measures that save money in the long-term may be rejected because they cost more initially.

Life-cycle costing is a means to calculate and compare different designs to identify which is the best investment. Districts can use it to assess the total cost of ownership for a facility over time. All of the building expenses that can be calculated are included in the analysis, including initial costs (design and construction); operating costs (energy, water, other utilities and personnel); and maintenance, repair, and replacement costs. The values are adjusted for the time-value of money to represent the true value of the investment. Predicted costs for alternative design approaches can then be compared, allowing the district to select the design that provides the lowest overall cost of ownership

A Closer Look – San Diego Unified School District, San Diego, CA.

San Diego Unified has taken steps to ensure that their new buildings are the most cost-effective options for all of their new construction projects. Language included to ensure high performance schools includes:

*"If the scope of the project includes mechanical work, the Architect shall require the Mechanical Engineer to provide a heating, ventilation, and air conditioning (HVAC) life-cycle analysis. **The Engineer shall submit three HVAC alternatives for conditioned buildings for review by the District. Each alternative shall include initial and life-cycling costs.** The selected alternative for the conditioned building(s) shall be modeled by using the most recent edition of Energy Pro or equivalent modeling software as approved by the District. **The program results should demonstrate the overall energy efficiency of the building(s) on a performance basis.** Modernization projects not suitable for modeling shall include prescriptive Title 24 calculations. **The Architect will participate in Utilities' rebate/ reimbursement programs as directed by the District."***

Process Steps

The table below outlines the general process of school construction and the key actions necessary to ensure that a high performance school is specified, designed, and constructed.

		Standard Process	Crucial High Performance Actions
1.	**Programing and Goal Setting**	**Determine need.** District conducts long range planning. Investigates population trends and current facilities to determine its long-term and current needs. **Educational specifications.** The educational specification is the primary tool to describe the school's educational goals, and set architectural guidelines to meet those goals. They may include information on the specific spaces to be included in the project, the area required for each space, the relationships between the spaces, and details on the mechanical, electrical, and technological systems. Information on the educational programs, including the curriculum and the methodology in which the curriculum is delivered, may also be included. The CDE highly recommends creating educational specifications. They consider the educational specification crucial to the development of high quality schools, and use it as a tool to educate the districts on relevant issues.	**Set high performance goals early and include them in district or educational specifications.** Including the goals in specifications is a crucial step. It becomes important and valuable when trade-offs and compromises must be addressed, and throughout the commissioning process to document the original design intent. The CHPS Criteria detailed in Volume III provides a flexible way to set goals. This point system covers the essential elements of high performance design and can be used by districts to clearly identify their priorities.
2.	**Site Analysis and Approval**	District selects site. SFPD conducts an initial review and may grant initial approval. The Department of Toxic Substances Control (DTSC) tests the site, and determines whether it is hazardous. After the site is deemed safe by the SFPD and DTSC, the site is approved. This process can take from a few months to several years to complete, depending on the level of toxins in the site and whether the surrounding community supports the construction.	**Minimize the impact of site.** Always consider location of site and recognize its impact on the health and safety of the facility. Ensure that the site is safe for the students and staff. Maximize the transit options of students, teachers, and staff. Document the exterior noise levels to ensure they are adequately addressed in the design. Building on previously developed land preserves green space. If building on a new site, disturb as little of the natural environment as possible, and restore damaged portions of the site. Design to reduce stormwater runoff.
3.	**Selecting the A/E Team**	The architectural and engineering (A/E) team must be competitively selected using qualification-based criteria. A fee is negotiated only after an A/E team has been selected on the basis of their qualifications. This process must be followed in order to receive state funding.	**Select design team with necessary qualifications** for designing a high performance school, and include the requirement for a high performance school in the negotiated design services. **Communicate goals to designers.** Goals should be included in the educational specifications and Request for Proposals to clearly communicate your design intentions.
4.	**Schematic Design**	During the conceptual design phase, key decisions on the basic scale and layout of the facility are made, and the project's overall scope and direction are established.	**Verify that high performance goals have been addressed.** Many key elements of the design are decided at this phase; modifying these decisions a later stages may prove to be difficult, costly, and sometimes impossible. **Pursue integrated design.** Insist on the development of an integrated design team to take benefit of design options that affect the entire building performance.
5.	**Design Development**	The design is refined and finalized as key building systems and materials (architectural, structural, mechanical, and electrical) are chosen and integrated. Depending on plan approvals, iterations between the designers and CDE/DSA may occur.	**Use goals as guides.** Trade-offs and compron are inevitable as the design develops. Be sure the designers have investigated the impacts of offs on the total building performance.

6.	**Construction Documents**	All design elements are finalized and the documents (drawings and specifications) that will guide the construction of the building are completed.	**Clearly specify high performance materials and equipment.** Many contractors do not have experience with high performance design or "green" materials, especially interior products such as carpets, low-VOC paints, adhesives, and surface finishes. Clearly specifying them in the contract documents will help ensure that the correct materials are used. Clearly identify a substitution and review process that includes the design team and the district, and allows the necessary time to reject a substitution request, if needed. The intent of the specifications are sometimes violated during this substitution process.
7.	**Plan Approval**	**Initial CDE plan approval.** The SFPD evaluates a schematic and final design of the proposed school in the context of the educational specification and school site safety. Once they feel that the design supports the district's educational mission and have determined that the site is free of hazards, they grant initial approval. **Final plan approval.** The final architectural and engineering plans are submitted to the DSA and SFPD for independent review. Plans do not need to be submitted concurrently. The districts must make all changes recommended by the DSA and SFPD prior to approval.	
8.	**Funding**	**Secure local funding.** Funding efforts that began with the decision to construct or renovate the building are secured. Districts seeking state money must secure 50% of the cost for new construction and 20% for renovations. **SAB eligibility approval.** If receiving state money, districts apply to the OPSC and must verify their eligibility in the program by proving a need for the construction. This can be done at any time in the design process, but must precede SAB approval. **SAB funding approval.** If receiving state money, districts apply to OPSC for funding and must provide proof that (1) local funding has been secured, (2) plans have been approved by DSA and SFPD, and (3) the site and plans have been approved by the CDE. In the event the district is unable to share in the construction cost, the district can pursue financial assistance through hardship provisions. Once the completed application is received, OPSC processes the application and forwards it to SAB for final approval and release of state funds.	**Communicate the value of high performance design with the community to help secure funding.** Educating the community about the academic, health, environmental, and monetary benefits of high performance design can help raise awareness and support for the new school.
9.	**Bidding**	Construction projects are competitively bid. The majority of contractors do not have experience with high performance design elements, and care must be taken to ensure that the design is not compromised during construction.	**Communicate goals to the contractors.** The bid process should require that competing contractors have experience and qualifications to construct high performance schools, including commissioning. If this is not appropriate, care should be taken that substitutions are made with caution and only replaced with materials with equal or better performance. **Monitor construction.** Be wary of substitutions or design changes (change orders) during construction that might occur without the consultation of the designer.
10.	**Construction Administration**	After the district hires the contractor, SAB releases the funds and construction begins. With all approvals and funding in place, the actual construction time on an average high school of 2,000 students takes approximately two years. Middle and elementary schools take less time. Total design development and construction time from concept to occupancy is between two to four years. When construction is complete, OPSC will perform a final audit.	
11.	**Occupancy**	Post-occupancy review and evaluation.	**Verify goals.** Commission the building to prove that that the building has been built as designed and meets district specifications. **Train occupants.** Maintenance personnel, teachers, and staff must understand how to use the building to maximize comfort and building performance.

INTERIOR SURFACES AND FURNISHINGS

This chapter provides guidelines for:

Guideline
Carpeting (Guideline IS1)
Resilient Flooring (Guideline IS2)
Ceramic Tile/Terrazzo (Guideline IS3)
Concrete Flooring (Guideline IS4)
Wood Flooring (Guideline IS5)
Bamboo Flooring (Guideline IS6)
Gypsum Board (Guideline IS7)
Acoustical Wall Panels, and Ceilings (Guideline IS9)
Paints and Coatings (Guideline IS10)
Casework and Trim (Guideline IS11)
Interior Doors (Guideline IS12)
Toilet Partitions (Guideline IS13)

Overview

The guidelines in this chapter provide advice on the selection of flooring, wall and ceilin
interior surfaces, and their associated coatings and adhesives. When selecting interio
high performance schools, designers should consider two questions:

- Does this product introduce chemical compounds into the space that will affect in
(IAQ)?
- Is this a material efficient product?

While many other characteristics, including acoustical performance and visual app
product decisions, selecting material efficient products that do not degrade indoor
main goals addressed in these guidelines. Evaluating resource efficiency and vo
compound (VOC) emissions is an emerging science with many uncertainties. N

COMMISSIONING AND MAINTENANCE

Introduction

Building owners spend more on complex building systems than ever before, yet many find they are not getting the performance they expect. A 1994 study of 60 commercial buildings found that more than half suffered from control problems. In addition, 40% had problems with HVAC equipment and one-third had sensors that were not operating properly.[44] An astonishing 15% of the buildings studied were actually missing specified equipment. And approximately one-quarter of them had energy management control systems, economizers, and/or variable speed drives that did not run properly. Problems also frequently occur on the envelope, structural, and electrical systems of many new buildings.

Schools are investments, and every new school is unique. In essence, each school design is a prototype expected to perform as if it were something that had been built before. Combining a new school design with modern technology, a tight construction schedule, and a fixed budget can lead to a building that does not perform as anticipated.

Building commissioning is one way to improve the outcome of a construction project. Neither the design team nor the district desires a poorly performing school. Unfortunately, school districts frequently are the ones left to deal with the resulting financial implications, including excessive repair and replacement costs, student absenteeism, indoor air quality problems, and construction team liability. Building commissioning can ensure that a new school begins its life cycle at optimal productivity, and improves the likelihood that it will maintain this level of performance.

Commissioning is a quality-assurance process that increases the likelihood that a newly constructed building will meet district expectations. Commissioning can optimize the energy-efficient design features and improve overall building performance. Districts can use this proven, systematic approach to reduce change orders and liability exposure, and to ensure that they receive buildings that function according to their original project requirements (design intent).

What Exactly Is Building Commissioning?

Commissioning is a systematic process of ensuring that all building systems perform interactively according to the contract documents, the design intent and the school's operational needs. This is achieved ideally by beginning in the pre-design phase with design intent development and documentation, and continuing through design, construction, and the warranty period with actual verification through review, testing, and documentation of performance. The commissioning process

[44] Piette, Mary Ann. Quantifying Energy Savings from Commissioning: Preliminary Results from the Northwest, in Proceedings of the National Conference on Building Commissioning, 1996.

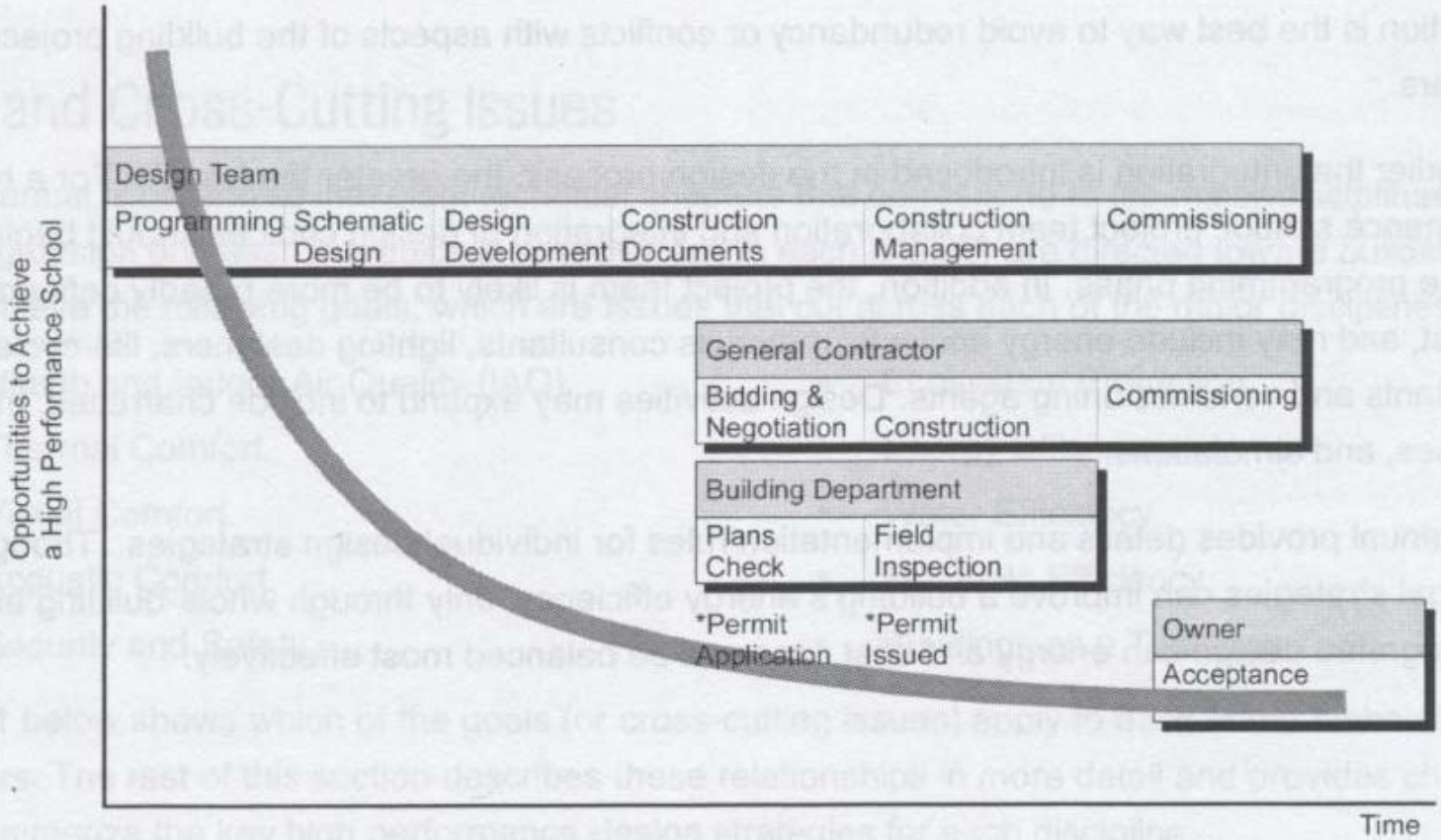


Figure 1 – Opportunities in the Design Process

What makes schools different from other buildings addressed by LEED

- **Charles Eley, FAIA, PE**
  CHPS Executive Director

LEED has a bias toward offices

- Schools are not offices

Lots of actors in the process

- Teachers
- Parents
- Administration
- Faculty
- Regulators
- Community

Schools are public places

- Musical and theatrical events
- Sporting events
- Weddings
- Social events
- Club meetings

Modernization and major renovations are at least as important as new constructions

The physical plants are often not a single building

- Multiple buildings in a campus-like setting
- Schools are often a collection of buildings, each with its own problems

Elementary and middle schools are relatively simple

- HVAC systems
- Lighting systems
- Building envelope

High schools can be complex

- Central chilled and hot water plants
- Energy management systems
- Advanced controls

Relocatable classrooms

Indoor environmental quality is more important

- Kids are captive in the classroom for 6 hours a day
- Kids are more sensitive to IEQ problems

Children are More Vulnerable

- Relative to their size, their breathing rates and metabolic rates are significantly greater than adults.
- Because children's bodies are actively growing, they absorb and retain more toxins.
- Children have less effective immune systems.
- Exposures to common molds and damp environments can cause childhood respiratory illnesses:
  - Persistent wheezing.
  - Shortness of breath.
  - Bronchitis.
- Students and staff have increasingly sensitized respiratory systems.
  - Sharp increases in both the prevalence and severity of asthma.
  - Rates in urban areas have been especially high.

IEQ quality includes

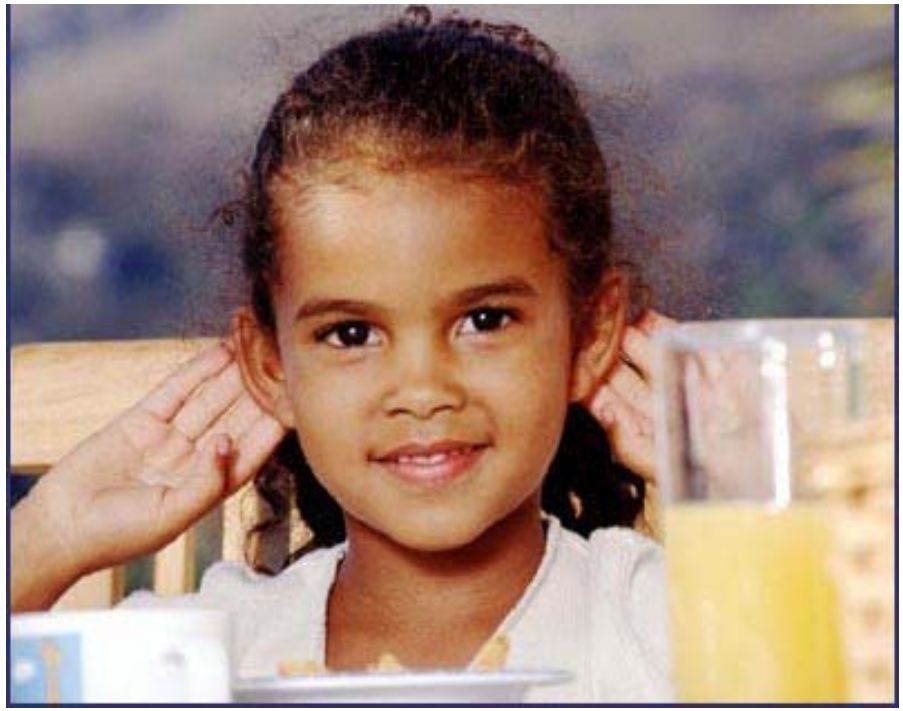
- Acoustics
  - Background sound power
  - Reverberation
  - Isolation from adjacent spaces and the outdoors
- Air
- Thermal comfort
- Light
  - Daylight
  - Electric lights

Speech Corrupted by Noise

- Uncorrupted speech (no noise)
- High speech-to-noise ratio

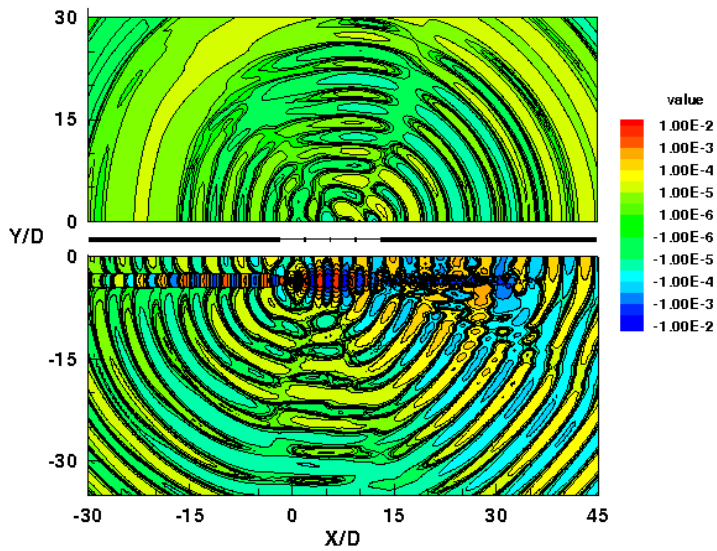
(Minimum goal of ANSI classroom standard)

- Medium speech-to-noise ratio
  - (Noise level increased by 5 dB)
- Low speech-to-noise ratio
  - (Noise level increased by 10 dB) David Lubman Associates
- Very Low speech-to-noise ratio
  - (Noise level increased by 15 dB)



Reverberated Speech Samples

- Dry speech (no reverberation)
- 0.6 second reverb. time
- 1.3 second reverb. time
- 5.0 second reverb. time



Teaching and learning performance is related to the physical quality of the classroom

- "Do School Facilities Affect Academic Outcomes", Mark Schneider
- A very thorough literature review showing the connection with:
  - Indoor air quality, ventilation and thermal comfort
  - Lighting
  - Acoustics
  - Building age, quality and aesthetics
  - School size
  - Class size
- National Clearing House for Educational Facilities
  www.edfacilities.org

Product delivery is different

- Construction manager at risk is common
- Design-build emerging
- Model or standard schools modified for different sites
- Budgets and schedules are tight
- No tolerance for delay (where are the kids going to go to school if we don’t finish on time)

Construction funding is different

- Developer fees
- Land donations in new developments
- Public bond funding
  - State
  - Local
- Each state is different

Special laws and regulations apply

- In California
  - State Department of Education sets standards
  - Department of Toxic Substances Control approves site
  - State architect approves plans and checks for compliance with California Building Code
  - State allocation board distributes money
  - Other agencies involved include
    - California Energy Commission
    - Air Resources Board
    - Water Resources Board
    - Waste Management Board
- Each state is different

Who are the stakeholders?

What is the process?